abundantly, while the herdsmen obtain water for them by digging holes in the sand of the river beds wherever water may be found in this manner. If the drouth still continues beyond this stage, the cattle are driven toward the coast to where water may be had, or they are left to perish of thirst.[1]

Without experience of such circumstances it is, perhaps, not easy to realize the force of the argument, but after riding for days through this region with a tropical sun blazing overhead, the atmosphere so dry that it seems to parch one's very vitals, and the heat from the glaring white sand quivering upwards to a cloudless sky, the thin *catinga* forest shriveled and still, with not a sign of animal life save the metallic stridulation of an occasional grasshopper, and after passing now and then a whole day without water, one realizes the importance which savage races, dwelling in such a country, would attach to a stream or pool where water could be had during the dry season.

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THE AMBLYPODA.

BY E. D. COPE.

(Continued from page 1121, November number.)[2]

PANTODONTA.

THERE is known as yet but a single family of this suborder, the Coryphodontidæ. Its representatives have been found in the lower lacustrine Eocene beds in Europe and North America in considerable abundance. About twenty species have been described, of which three have been found in England and France, and the remainder in the Rocky Mountain region of North America. They form a curious and interesting group of hoofed Mammalia which did not survive the Lower Eocene time, except in their probable descendants, the Dinocerata. The characters of the suborder have already been given in the NATURALIST, page 1111.

Five genera of the Coryphodontidæ are known from dental characters. Two of these, Coryphodon and Bathmodon, are known in their skeletal structure, the first-named very thoroughly.

[1] The circumstances under which I found the remains of extinct mammals in this region lead me to believe that their extermination was caused by long drouths over great areas.

[2] The explanations of Fig. 7 (p. 1115) should read four-ninths nat. size; not two thirds nat. size.

Bathmodon is nearest to the genus Pantolambda in its foot structure. The astragalus has the same subquadrate outline (compare Figs. 3 *d* and 19 *a*), and possesses, as in that genus, a facet on its internal anterior angle, for another bone. This character is found among recent Mammalia in certain rodents, where a separate bone, the internal navicular, articulates with the internal extremity of the astragalus. This is probably the case in Bathmodon and Pantolambda, but the separate bone has not been found. In Coryphodon it is evidently wanting, as the astragalus terminates internally in a hook-like apex, which gives it a very peculiar appearance (Fig. 2). Until I traced this astragalus to Coryphodon in 1873,[1] the relation of this genus to the Dinocerata had not been suspected.

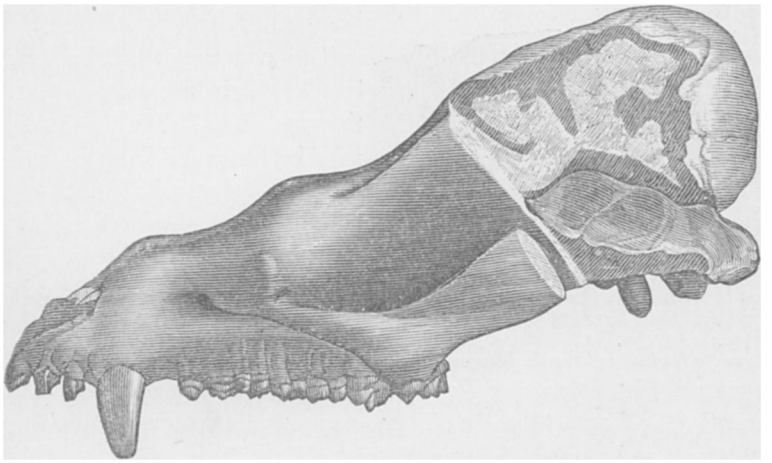

FIG. 12.—*Coryphodon elephantopus* Cope, skull from left side, the left half of the posterior part removed so as to display the small size of the brain cavity; two-ninths natural size. From Wasatch bed of New Mexico. Original.

The small size of the brain in this family is well displayed in the section of the skull of Coryphodon represented in Fig. 12, where the cavity it has occupied is exposed. Its relations to the skull are entirely different from those observed in all recent Mammalia excepting the elephants. As in them the diploë is represented by large air chambers.

The characters of the brain itself may be learned from Fig. 13. The exceedingly small size of the cerebral hemispheres at once arrests the attention, being much smaller than in the

[1] On the short-footed Ungulates of the Eocene of Wyoming. Proceedings Amer. Philosoph. Society.

cotemporary genus Phenacodus,[1] and agreeing with Uintatherium, which has been described by Marsh. There is no trace of sylvian fissure nor of convolutions. The middle brain is entirely exposed, and how much pertains to this and how much to the cerebellum remains uncertain. The anterior prolongation of the anterior pyramids is visible below the middle brain, as though the pons varolii were wanting (Fig. 13 *p*).

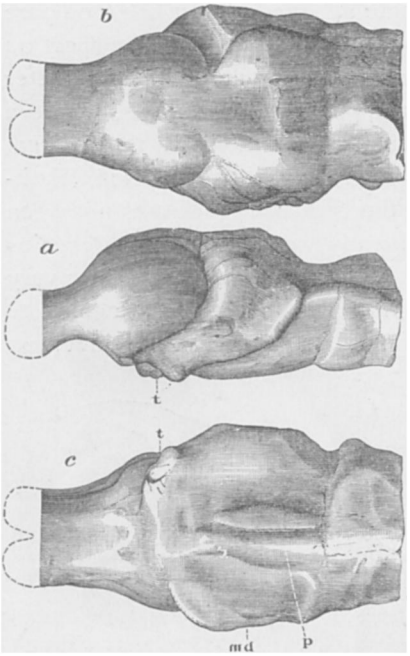

FIG. 13.—*Coryphodon elephantopus* Cope, cast of brain cavity seen in fig. 12, about one-third nat. size. Fig. *a*, left side; *b*, above; *c*, below. *t*, origin of trigeminus nerve; *p*, anterior pyramids. Original, from Proceed. Amer. Philos. Soc., 1877.

The characters of the long bones which are common to the members of this family may be observed in the *Bathmodon pachypus*, Figs. 14–15. The humerus shows the robust but not hooked tuberosities of the head, and the simple condyles. The radius shows the simple transverse head and the lateral distal facet. The femur (Fig. 15 *b*) has well developed trochanters, including the third, and a fossa ligamenti teris. The ilium (Fig. 15 *a*) like that of animals with a large belly, is much expanded, and has a wide peduncle. The pubis and ischium are light.

The five genera of Coryphodontidæ differ as follows:

I. Superior molars with two interior cusps.

All the superior molars with a well-marked external posterior V.....*Manteodon.*

II. Last superior molar with but one inner cusp or angle.

a. Last superior molar with posterior external cusp.

Anterior two molars with posterior external V.....*Ectacodon.*

aa. Last superior molar without external posterior cusp.

†Anterior two molars with posterior external V.

Astragalus transverse, with internal hook and no facet.....*Coryphodon.*

Astragalus subquadrate, with an internal facet and without internal hook, *Bathmodon.*

††First superior molar only, with posterior external V.....*Metalophodon.*

[1] See NATURALIST, 1884, p. 898, for figure.

The general relation of the teeth of these genera to those of other families of the order has been discussed (supra p. 1117). Their relation to each other may be understood by comparison of Fig. 9 *a* and *f* with Fig. 16. In the latter the anterior external V is marked a, and the posterior p. The posterior exterior angle of the latter is designated by the letter e. In Manteodon (Fig. 9 *f*) the posterior external V is observed to be well developed on the last superior molar. In Ectacodon (Fig. 16 *a*) its posterior edge is represented by an external cusp only (e), the rest of the border

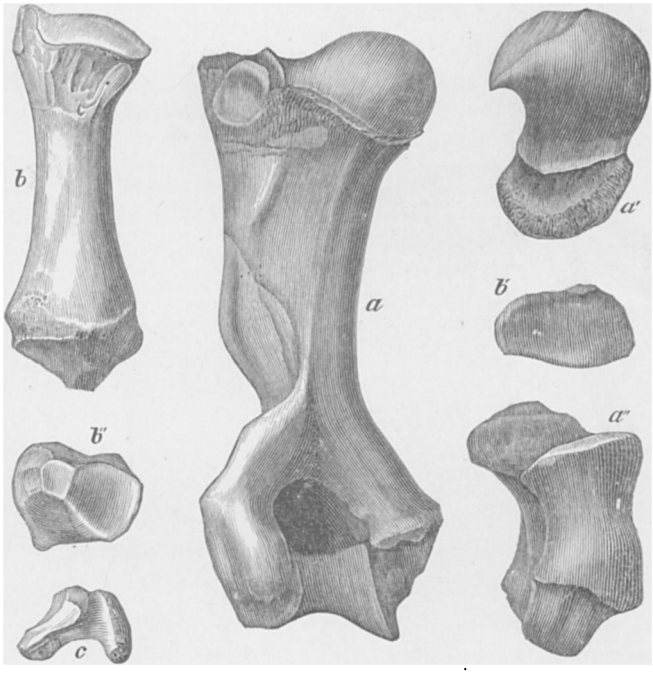

FIG. 14.—*Bathmodon pachypus* Cope, bones of fore limb, one-fifth nat. size, from Wasatch beds of Wyoming. Fig. *a*, left humerus from behind; *a'*, proximal, *a''*, distal views. Fig. *b*, left radius from behind; *b'*, proximal, *b''*, distal views; *c*, pisiform bone. From Vol. III Report U. S. Geol, Survey, F. V. Hayden.

being absent. In Coryphodon this border is sometimes traceable (*C. anax*, Fig. 9 *a*) or is wanting. In Metalophodon it is entirely absent, and is represented by a conical projection of the posterior crest only (Fig. 16 *b* p). The posterior V of the second superior molar is distinct in all except Metalophodon (Fig. 16 *b* p), where it is represented by a crest only, as in the last molar of most of the species of Coryphodon. The succession is thus seen to consist of the gradual conversion of the external Vs into

transverse crests, a process which is consummated in the Dinocerata of the later Bridger epoch (see Fig. 10).

Of Bathmodon two species are known, *B. radians* (Fig. 18) and *B. pachypus* (Figs. 14, 15 and 19). The latter is the larger,

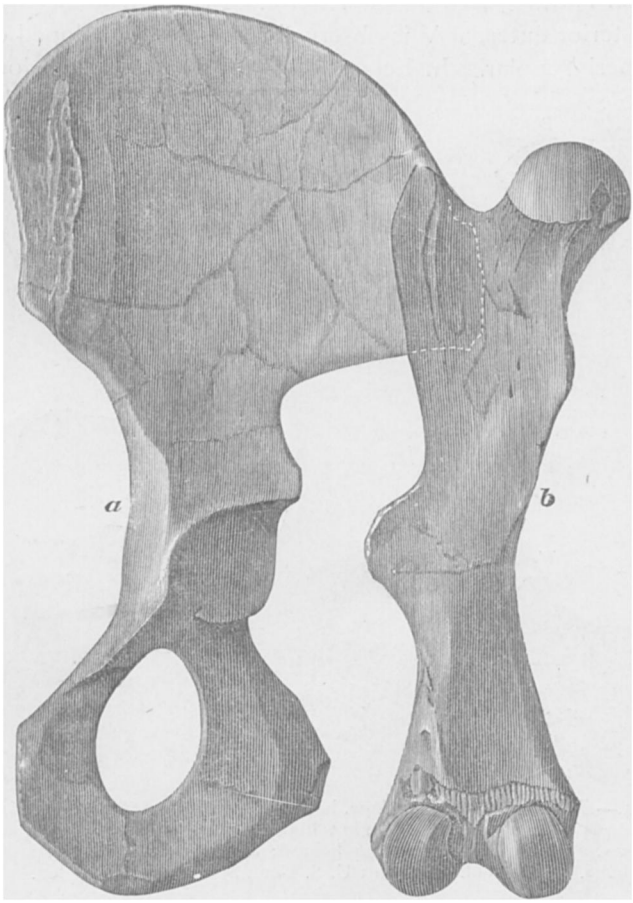

FIG. 15.—*Bathmodon pachypus* Cope, bones of individual figured in Fig. 14, one-fifth nat. size. Fig. *a*, left innominatum, somewhat distorted, internal view; *b*, left femur from behind. Original, from Wasatch beds of Wyoming.

equaling a large ox in dimensions. The crania of these species are unfortunately unknown. Both are from the Wasatch beds of Wyoming.

Of Ectacodon Cope, but one species, the *E. cinctus*, has been

discovered. It is only known from the superior molar teeth fig-

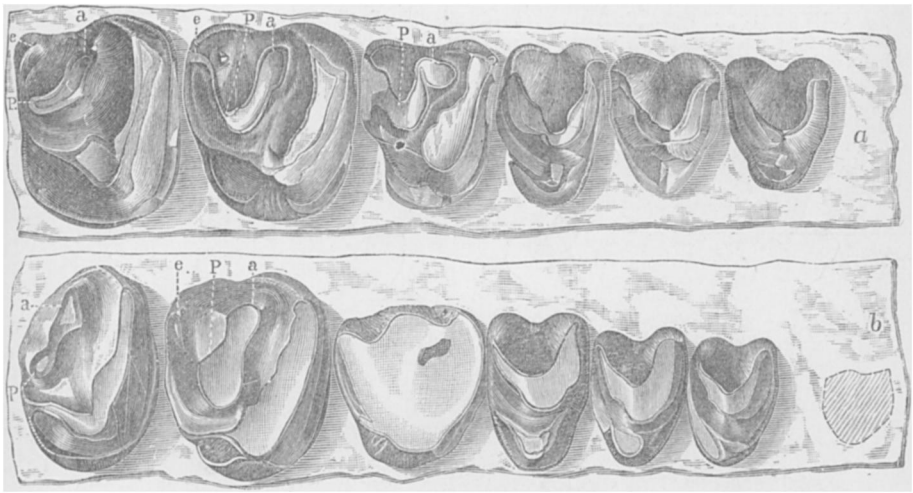

FIG. 16.—Superior molar series of Coryphodontidæ, two-thirds nat. size, from the Wasatch beds of Wyoming. Original. Fig. *a*, *Ectacodon cinctus* Cope. Fig. *b*. *Metalophodon testis* Cope.

ured in Fig. 16 *a*. It is a large species, about equal to the *Bathmodon radians*.

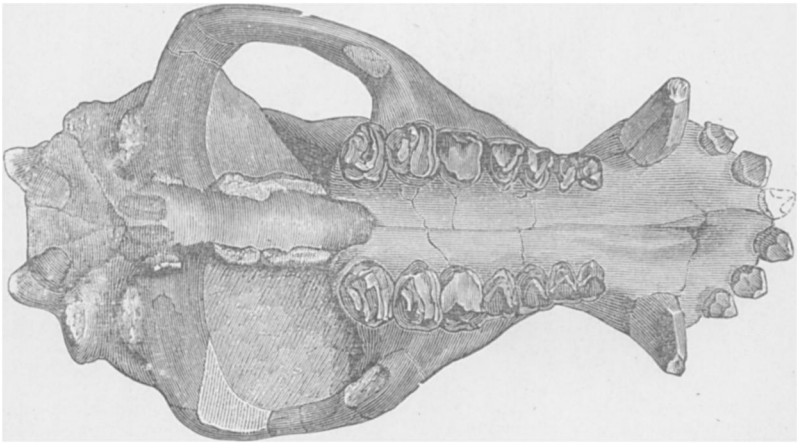

FIG. 17.—*Coryphodon elephantopus* Cope, skull, two-ninths nat. size, from below. Original, from Report G. M. Wheeler, U. S. G. G. Surv. W. of 100th mer., Vol. IV, pt. II.

The greater number of species of the family belong to Coryphodon. In this genus the temporal fossæ are lateral, as in modern ruminants, leaving a wide front with overhanging tem-

poral ridges (Figs. 20-21). The dental formula is the complete one of I. $\frac{3}{3}$; Pm. $\frac{4}{4}$; M. $\frac{3}{3}$. The superior canines are very powerful, and have three sides, giving a triangular section. In some of the species (*C. molestus*), this tooth is more compressed

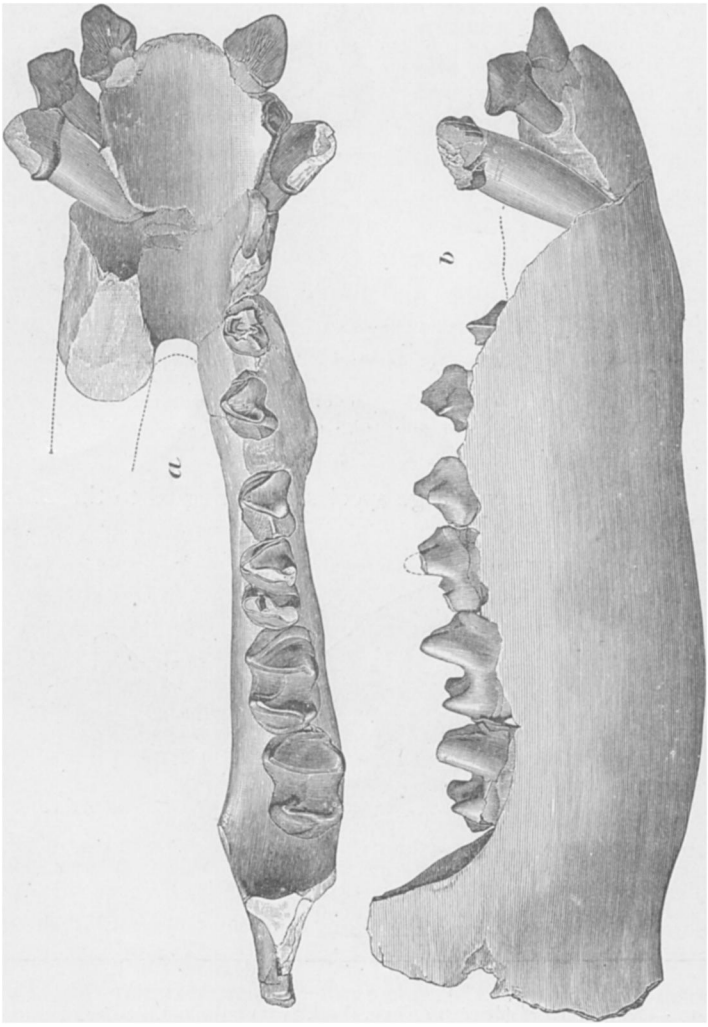

FIG. 18.—Lower jaw associated with the foot bones of *Bathmodon radians* Cope, from the Wasatch beds of Wyoming, three-eighths nat. size. From the small size of the canine probably a female. Original.

towards the apex, and the posterior face is narrow and concave, forming a groove. The inferior canines are also triangular in section, and the anterior angle is produced into an ala at the base (Figs. 9 *c*, 23 *i*). The neck and tail are of median length.

The general appearance of the Coryphodons, as determined by

the skeleton, probably resembled the bears more than any living animals, with the important exception that in their feet they were much like the elephants. To the general proportions of the bears must be added a tail of medium length. Whether they were covered with hair or not is, of course, uncertain; of their nearest living allies, the elephants, some were hairy and others naked. The top of the head was doubtless naked posteriorly, and in old animals may have been only covered by a thin epidermis, as in the crocodiles, thus presenting a rough, impenetrable front to antagonists.

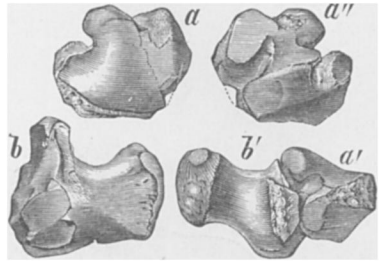

FIG. 19.— *Bathmodon pachypus* Cope, bones of foot of individual represented in figs. 14 and 15, one-fifth nat. size. Fig. *a*, astragalus from above; *a'*, inner side; *a''*, below. Figs. *b b'*, calcaneum.

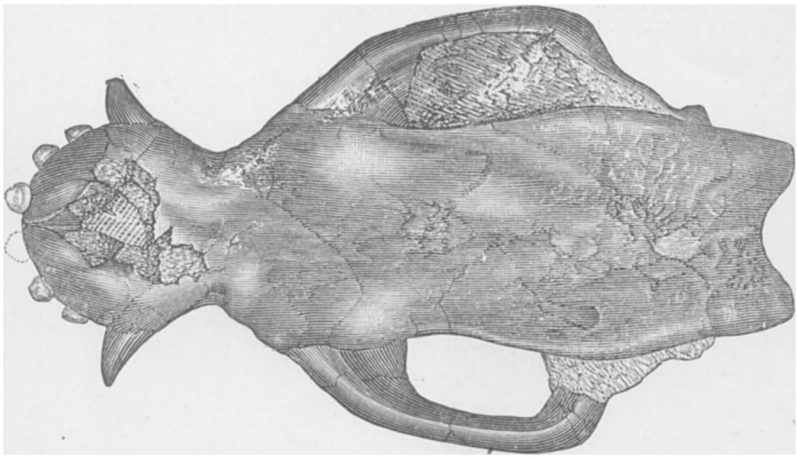

FIG. 20.—*Coryphodon elephantopus* Cope, skull figured in figs. 12, 17 and 21, two-ninths nat. size, from above. From Wasatch bed of New Mexico. Original, from Report U. S. G. G. Surveys and G. M. Wheeler, Vol. IV, pt. II.

The movements of the Coryphodons doubtless resembled those of the elephant in its shuffling and ambling gait, and may have been even more awkward from the inflexibility of the ankle. But in compensation for the probable lack of speed these animals were most formidably armed with tusks. These weapons, particularly those of the upper jaw, are more robust than those of the Carnivora, and generally more elongate, and attrition preserved rather than diminished their acuteness. The size of the species varied from that of a tapir to that of an ox.

We must suppose that the Coryphodons were vegetable feed-

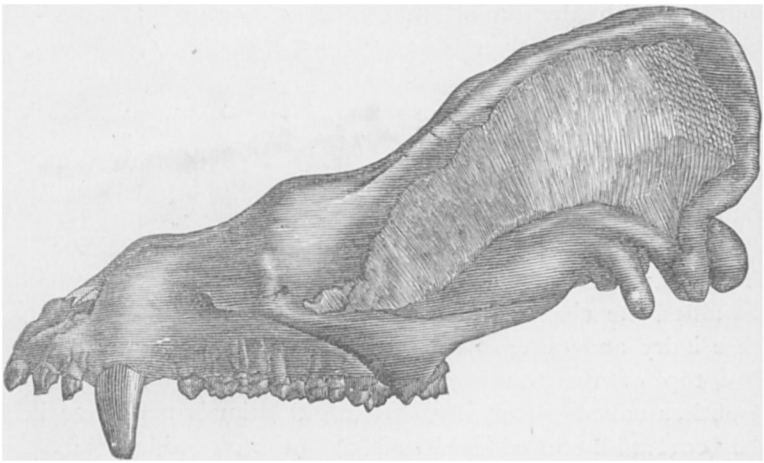

FIG. 21.—*Coryphodon elephantopus* Cope, skull from left side, two ninths nat. size. From Wasatch bed of New Mexico. Original, from Report U. S. G. G. Survey W. of 100th mer., Vol. IV, pt. II.

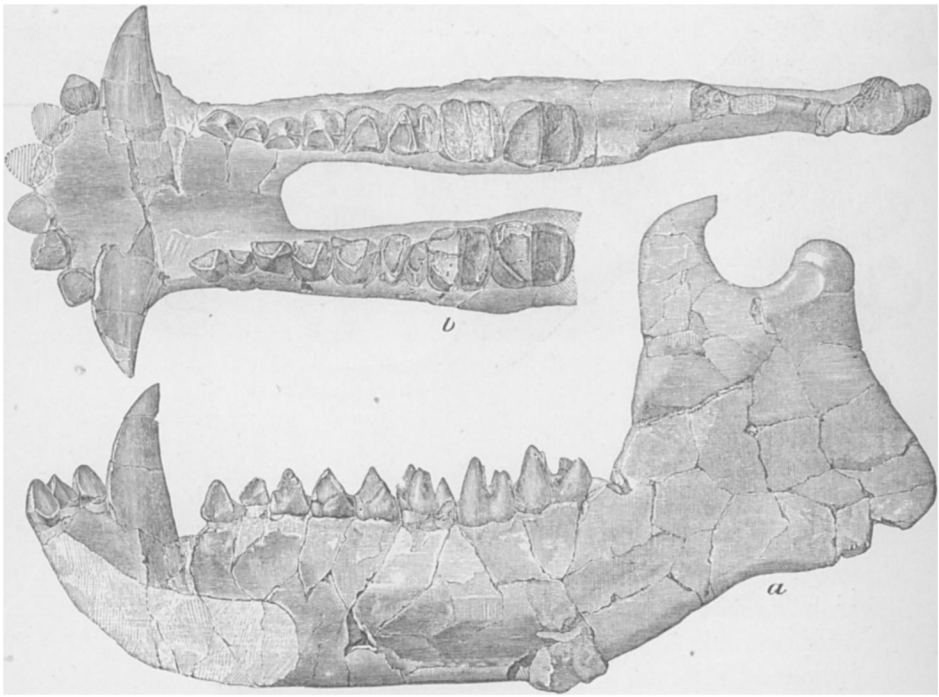

FIG. 22.—*Coryphodon latidens* Cope, lower jaw, one-third natural size, from the Wasatch epoch of New Mexico. Fig. *a*, right ramus from internal side. Fig. *b*, both rami from above. Original, from Report U. S. G. G. Surveys W. of 100th Mer., G. M. Wheeler in charge. This specimen has an anomalous premolar.

ers, but not restricted to any particular class of food. They were doubtless, to a large extent, like the hogs, omnivorous.

Fourteen species of this genus have been described. They range in size from the dimensions of a tapir to those of an ox. In the absence of the bones of the skeleton the species may be distinguished by the inferior true molars, which are fortunately the parts most frequently preserved. The simplest form is that where the posterior crest of the posterior true molar is transverse, and there is no crest or cusp accessory to it on the inner edge of the crown, as in *C. latidens* (Fig. 22). A change in the form of this crest is seen in the *C. curvicristis*, where it is curved forwards at the inner extremity so as to enclose a crescent-shaped valley. This species adds several other peculiarities of this tooth, as the presence of two oblique crests in front of the anterior cross-crest (Fig. 22). The superior incisors are angulate on the external face. The species was of about the same size as the *C. latidens*.

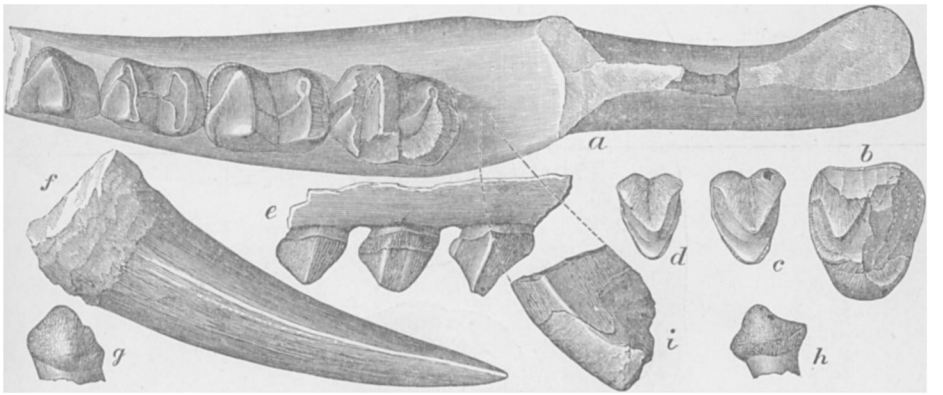

FIG. 22.—*Coryphodon curvicristis* Cope, portions of jaws with teeth, one half natural size, from the Wasatch bed of Wyoming. From Report U. S. Geolog. Survey Terrs., Vol. III. Original. Fig. *a*, right mandibular ramus with true molars and Pm. IV, from above. Fig. *b*, penultimate superior molar from below; *c d*, superior premolars from below; *e*, superior incisors, external side; *f*, superior canine, crown only; *g h*, inferior incisors, external views; *i*, inferior canine, base of crown.

The posterior cross-crest may send off the internal marginal crest at an angle, as in *C. eocœnus* Ow., or *C. obliquus* Cope. The internal marginal crest may rise into a low tubercle, as in *C. lobatus* or *C. anax* (Fig. 23 and 9 *b d*). In this case the posterior cross-crest may be very oblique, as in *C. anax*, thus giving the appearance of a heel or fifth lobe to the crown. This is indeed the character of such a crown, which if compared with that of the *C. latidens* only might suggest generic separation, but we

have every intermediate condition. Finally this internal ridge may develop into a conic cusp, as in the *C. cuspidatus* (Fig. 9 *e*).

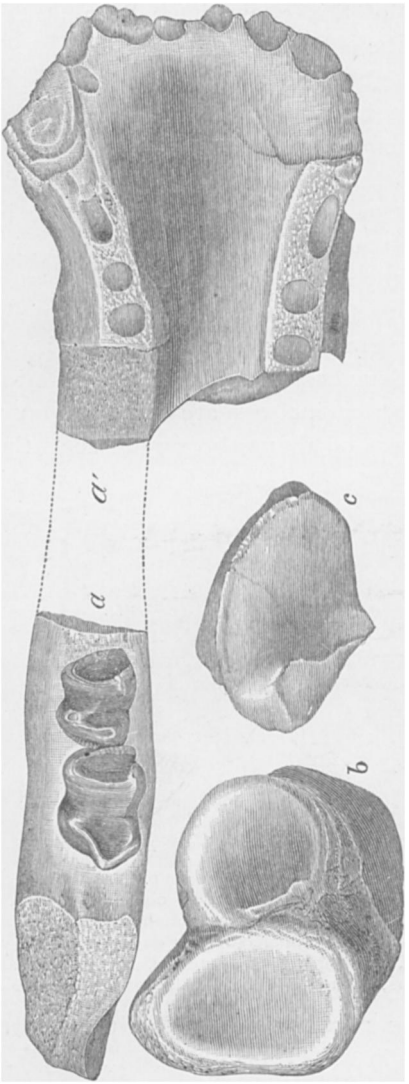

FIG. 23.—*Coryphodon anax* Cope, bones, two-fifths nat. size; individual represented in Fig. 9 *b*. From the Wasatch bed of Wyoming. Figs. *a a'*, mandible, less right ramus, viewed from above. Fig. *b*, head of tibia; *c*, distal extremity of tibia, end views. Original, from Report U. S. Geol. Survey Terrs., Vol. III, F. V. Hayden.

Of Metalophodon two species are known, the *M. testis* (Fig. 16 *b*) and *M. armatus* Cope, both from the Wasatch beds of Wyoming. Both species are of about the size of the *Coryphodon latidens*, and smaller than the *C. anax*. The skeletons are unknown.

(To be continued.)